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**Chang et al.**

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(54) **EXERCISE APPARATUS**

(71) Applicants: **Ziv Chang**, Taichung (TW); **Joe Chen**, Cottage Grove, WI (US); **Noel Johnson**, Stoughton, WI (US); **Derek Nelson**, Lake Mills, WI (US)

(72) Inventors: **Ziv Chang**, Taichung (TW); **Joe Chen**, Cottage Grove, WI (US); **Noel Johnson**, Stoughton, WI (US); **Derek Nelson**, Lake Mills, WI (US)

(73) Assignee: **Johnson Health Tech Co., Ltd.**, Taichung (TW)

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**A63B 22/06** (2006.01)  
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**A63B 22/00** (2006.01)

(52) **U.S. Cl.**

CPC ..... **A63B 22/001** (2013.01)

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A63B 22/06; A63B 22/0605; A63B 22/08;  
A63B 22/0664  
USPC ..... 482/51, 52, 57, 58–65  
See application file for complete search history.

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*Primary Examiner* — Stephen Crow

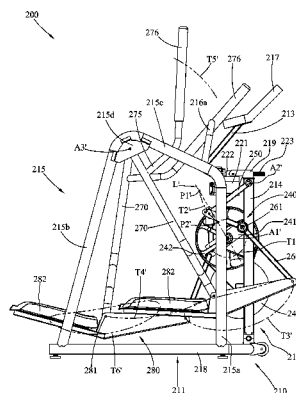
*Assistant Examiner* — Garrett Atkinson

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**ABSTRACT**

An exercise apparatus includes a frame, two crank units, two reciprocating members, two swing arms, two linkages and two carrying arms. A predetermined portion oriented between the top and bottom ends of each linkage is pivotally coupled to the corresponding crank unit and is moved along a circular path. The top end of each linkage is pivotally coupled to the corresponding reciprocating member and is moved along a curved path between two retracing points. The front end of each carrying arm is pivotally coupled to the bottom end of the corresponding linkage and is moved along a first closed path which is elliptical-like shaped. A predetermined portion oriented between the front and rear ends of each carrying arm is pivotally coupled to the bottom of the corresponding swing arm. The rear end of the carrying arm supports user's foot and is moved along a second closed path.

**9 Claims, 14 Drawing Sheets**



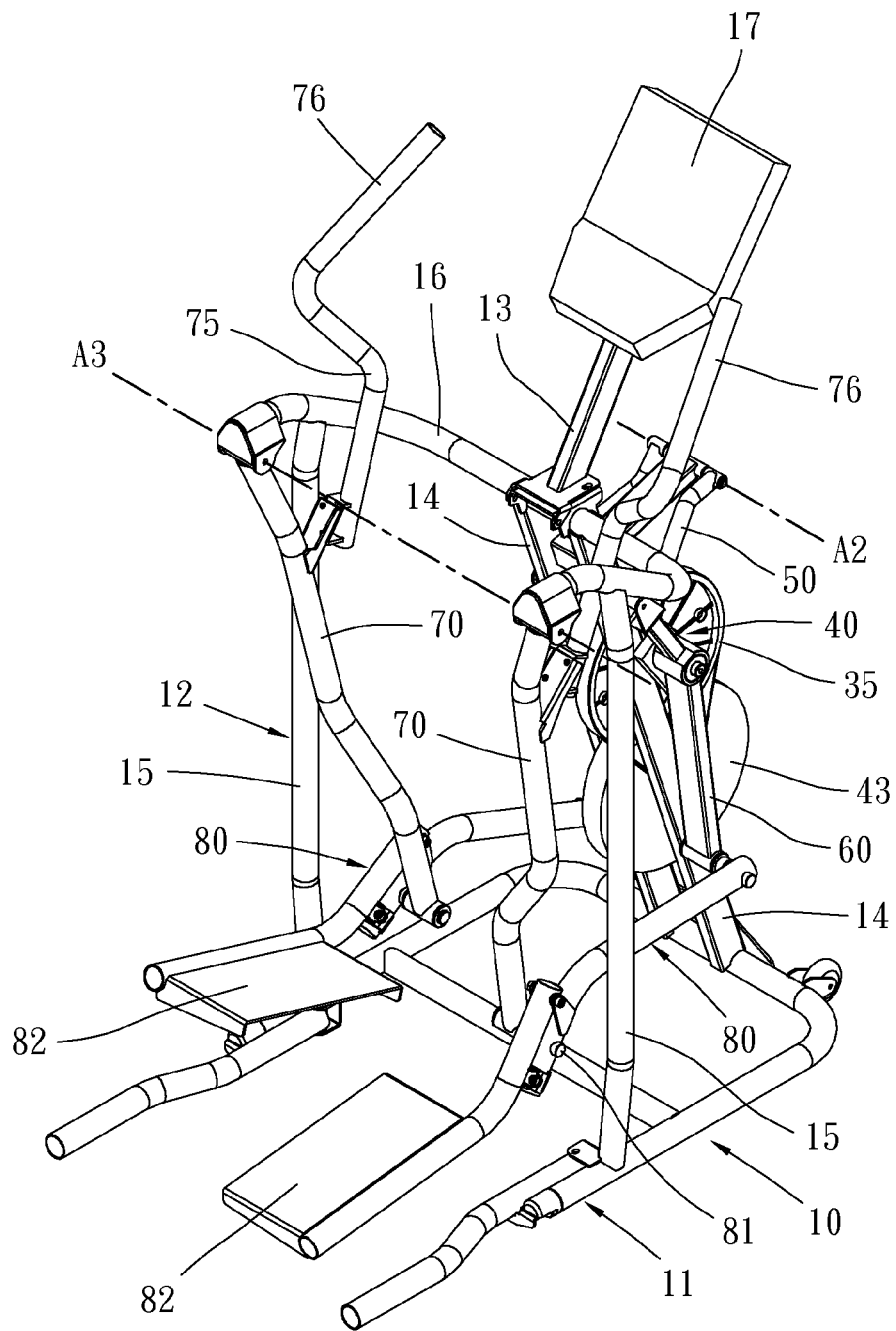


Fig. 1

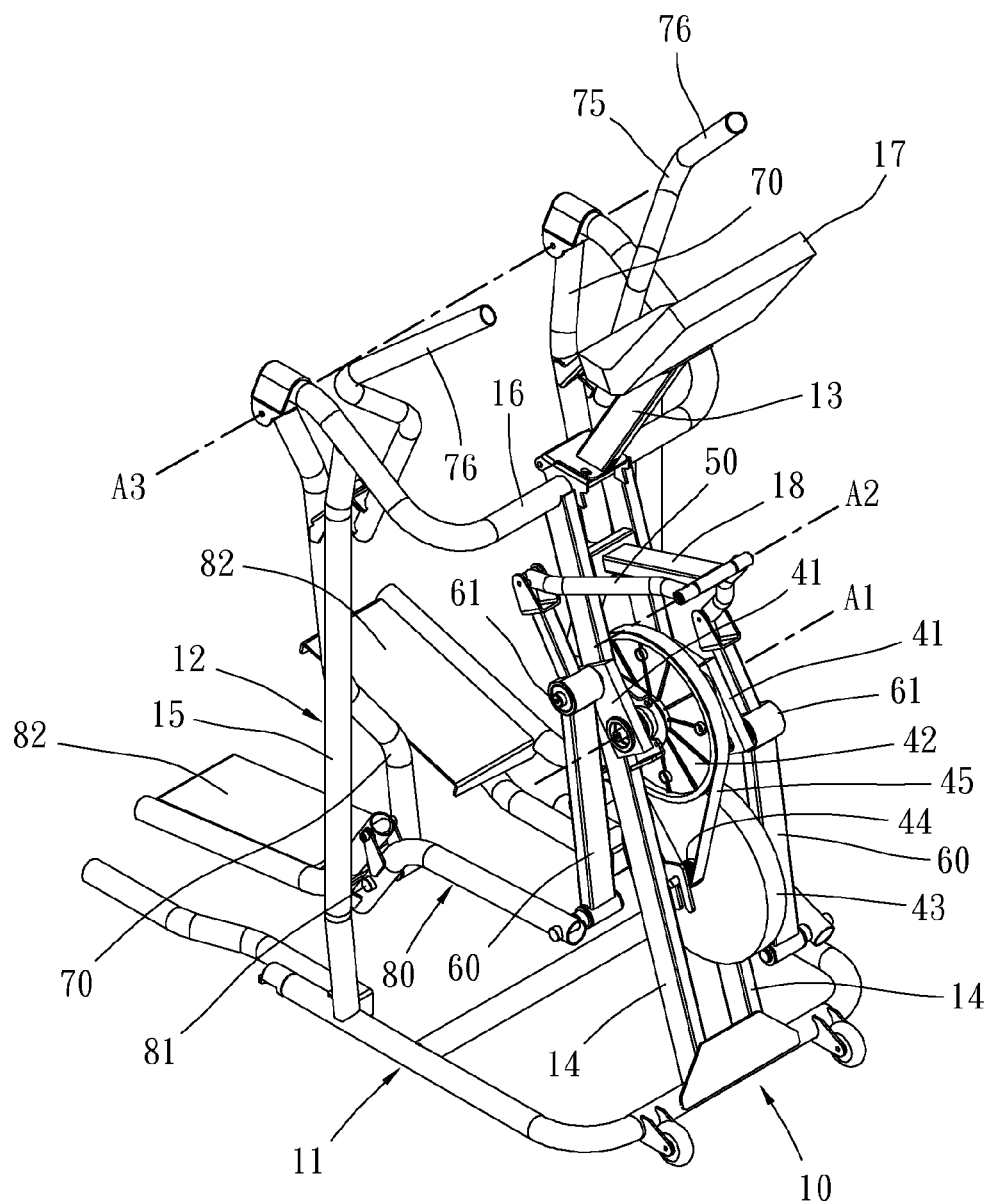


Fig. 2

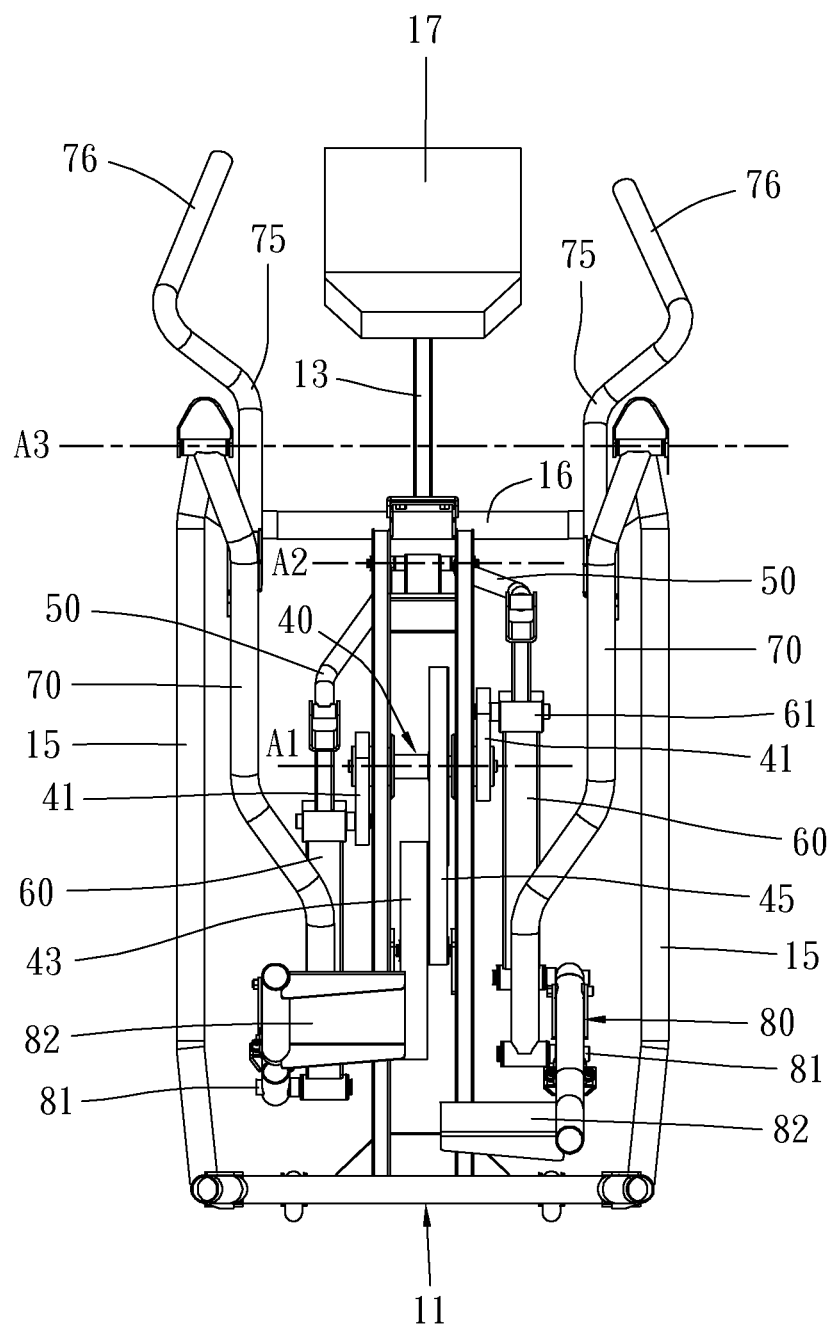


Fig. 3

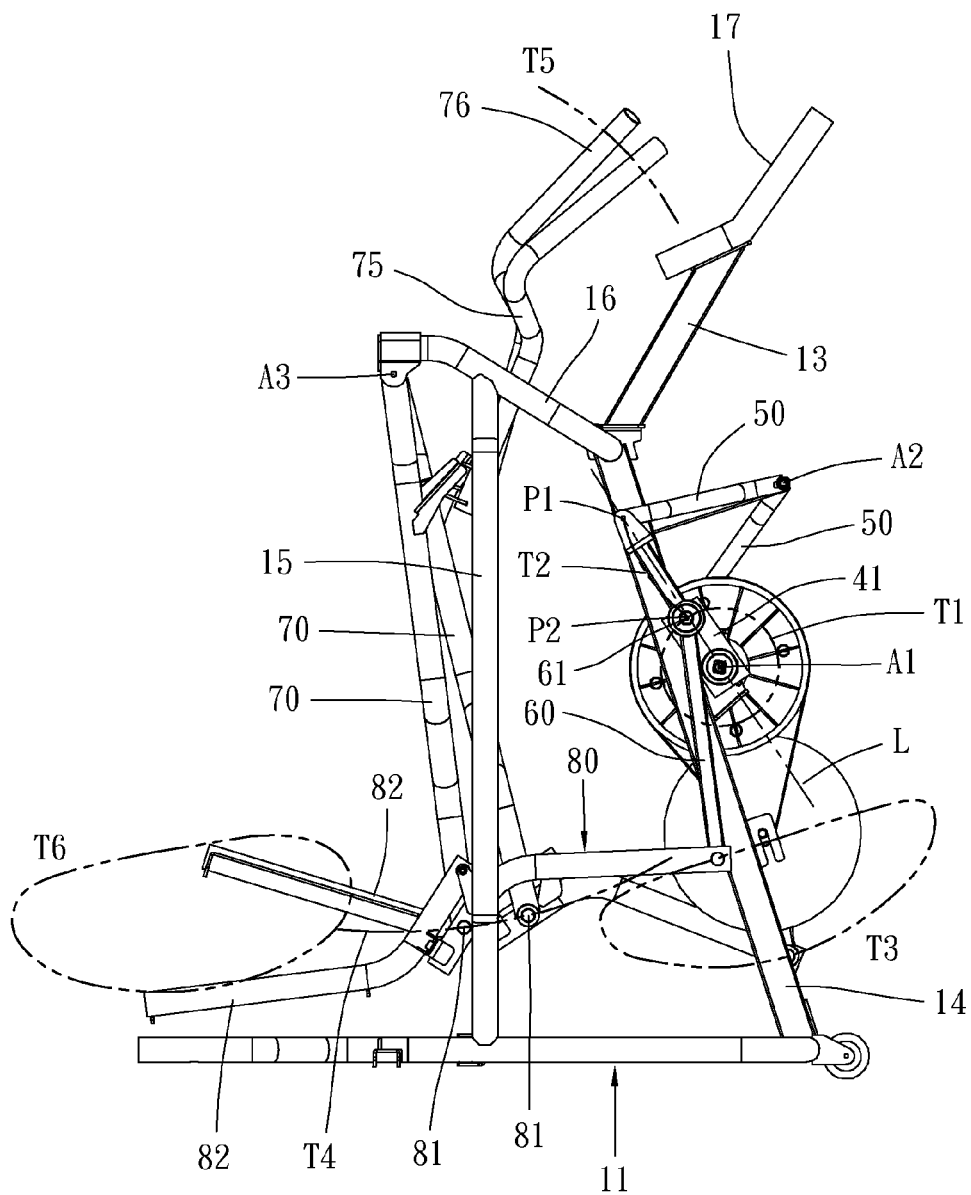


Fig. 4

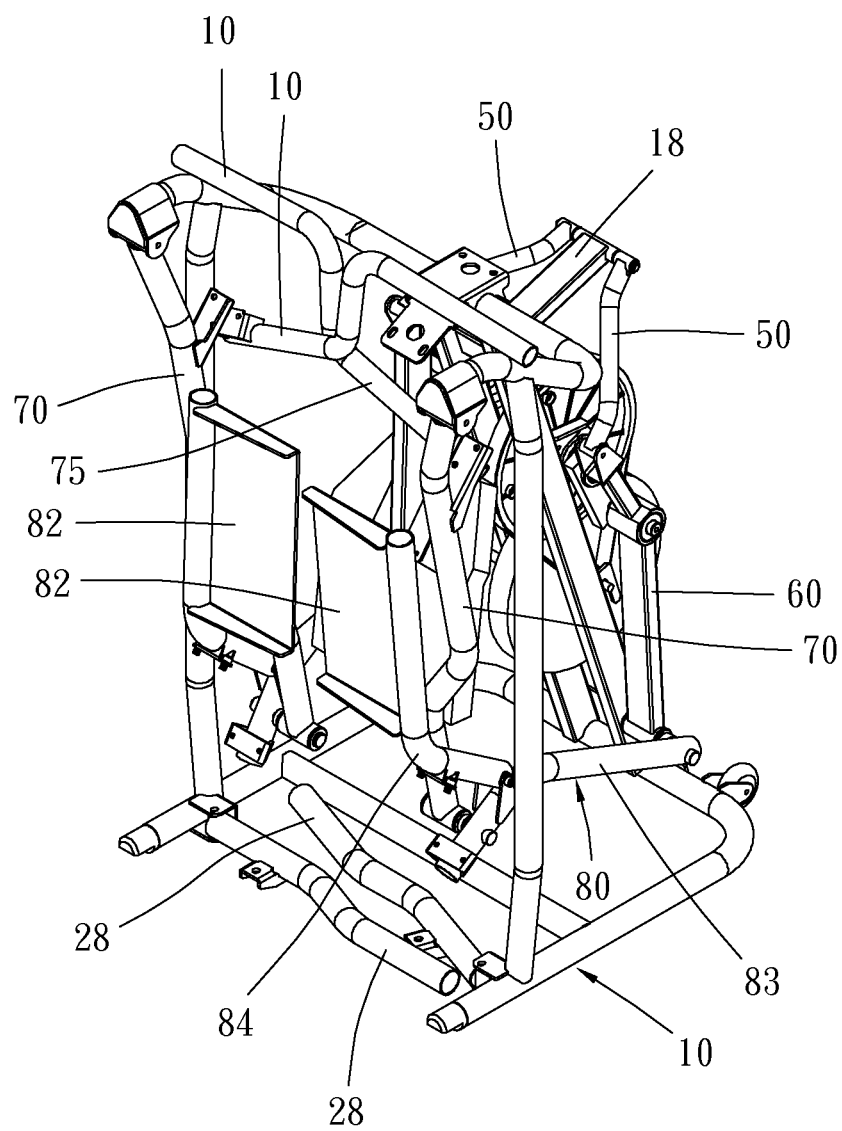


Fig. 5

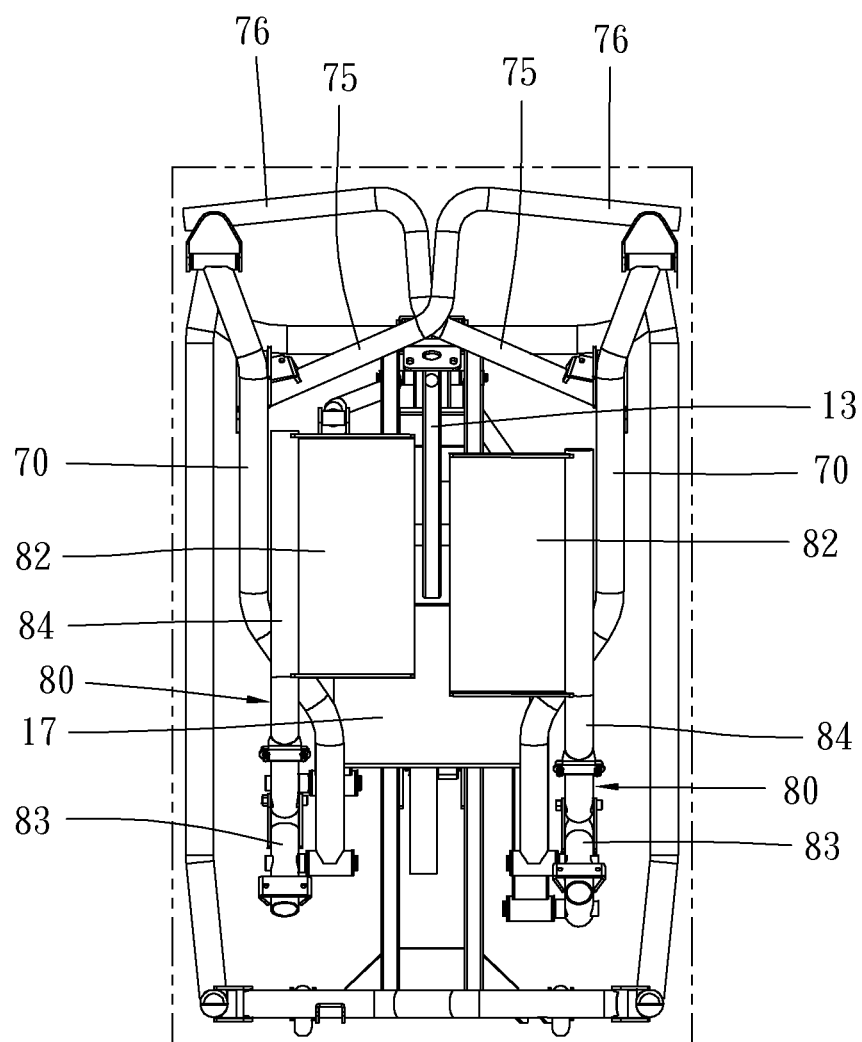


Fig. 6

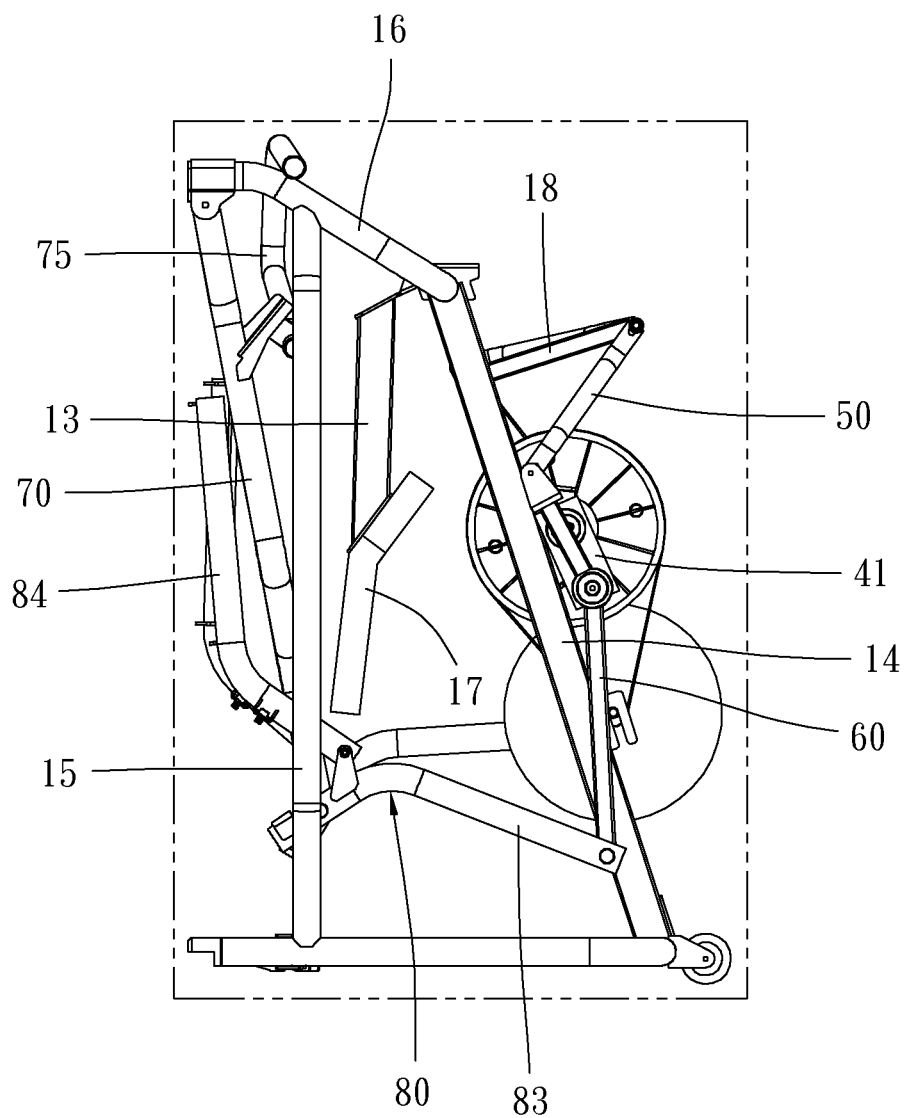


Fig. 7



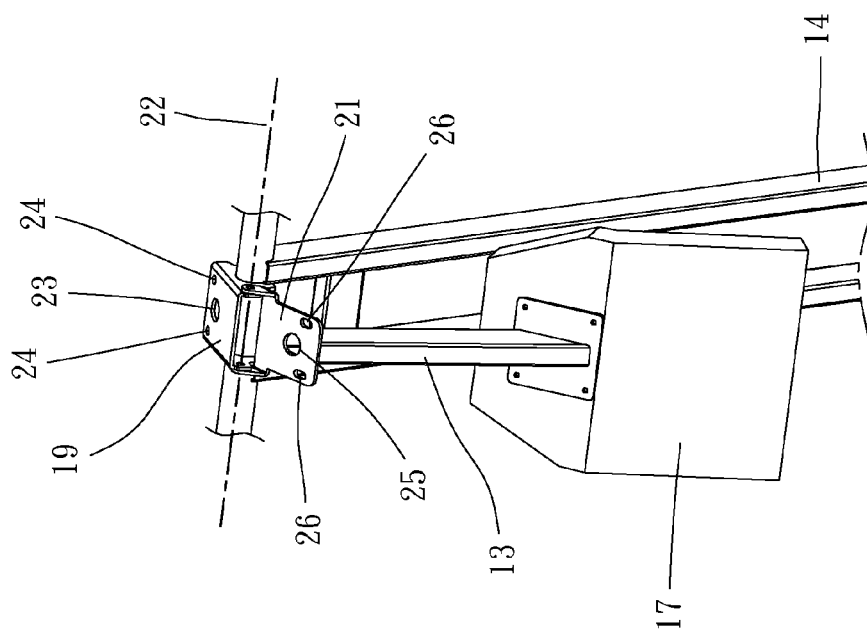


Fig. 8-B

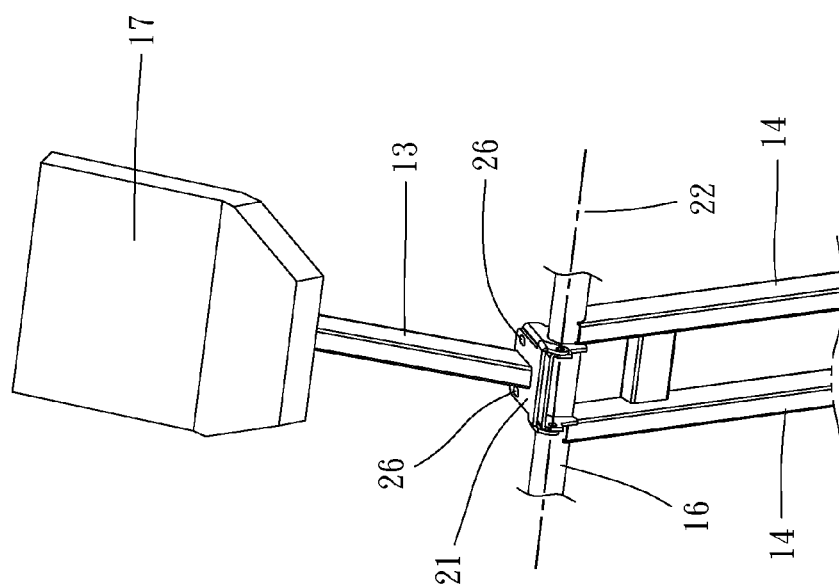


Fig. 8-A

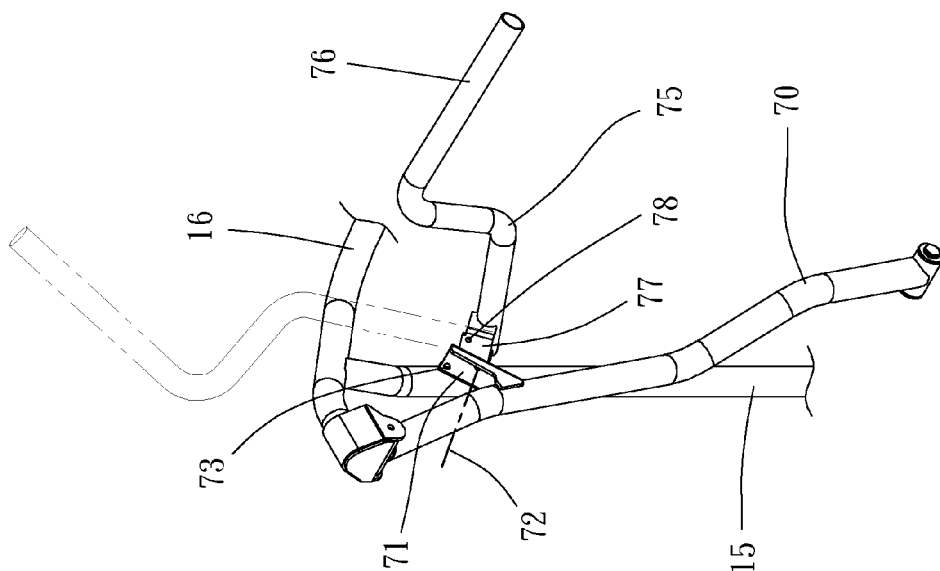


Fig. 9

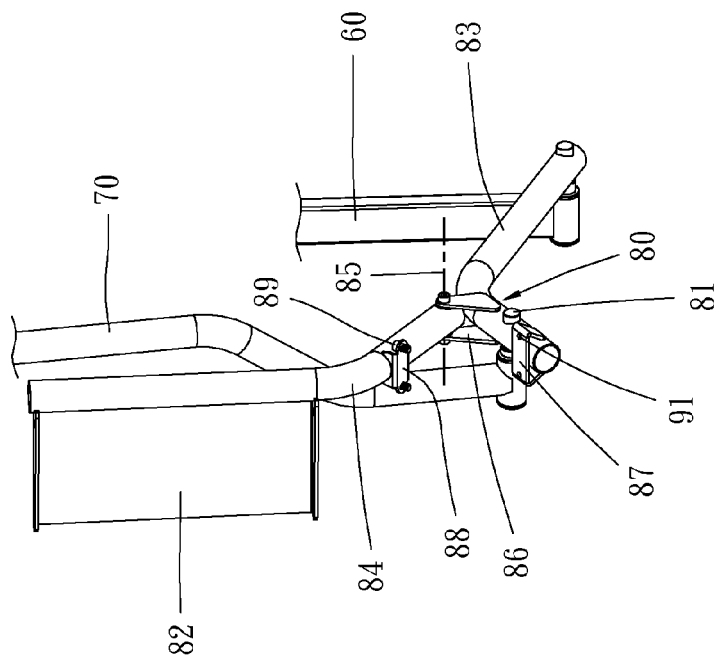


Fig. 10

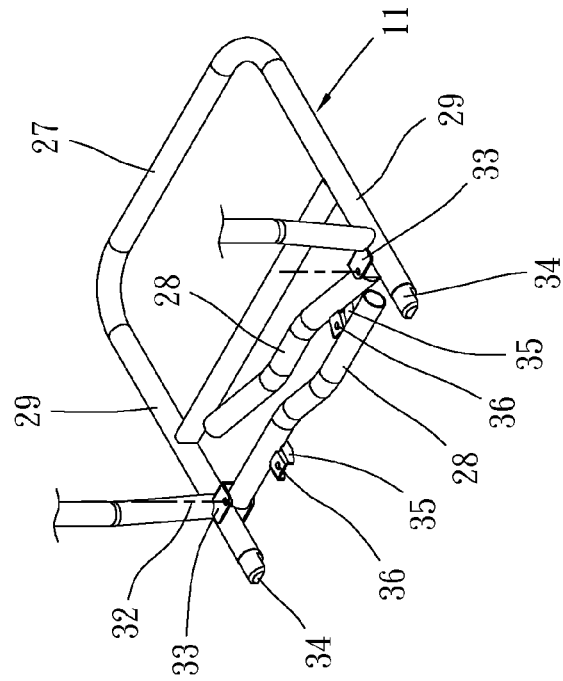


Fig. 11-B

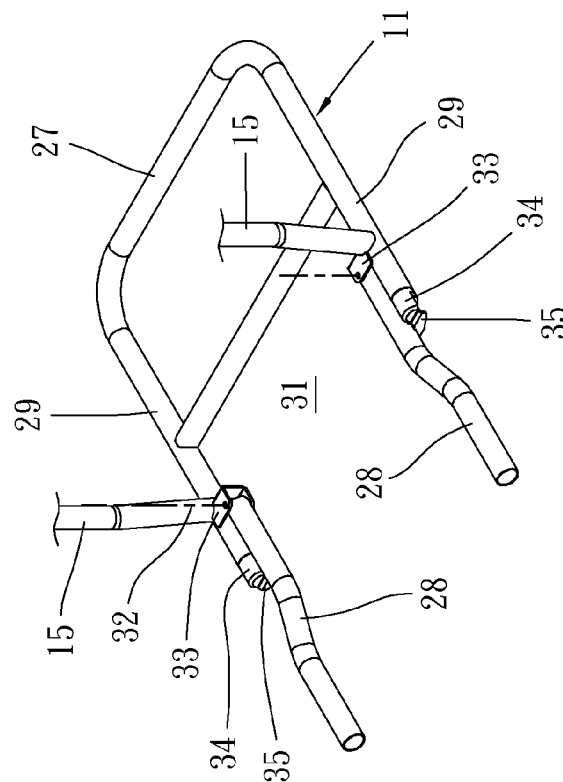


Fig. 11-A

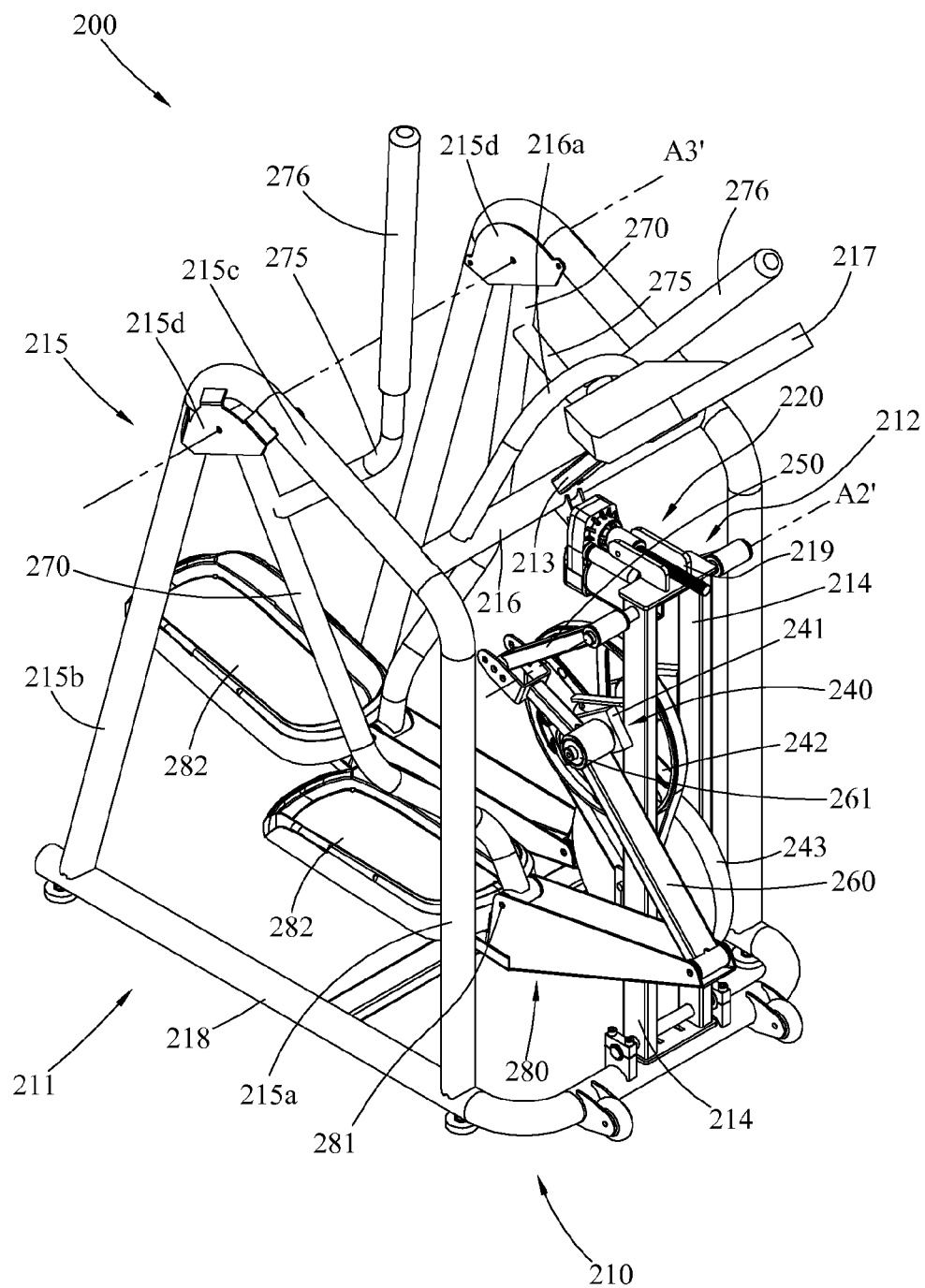


Fig. 12

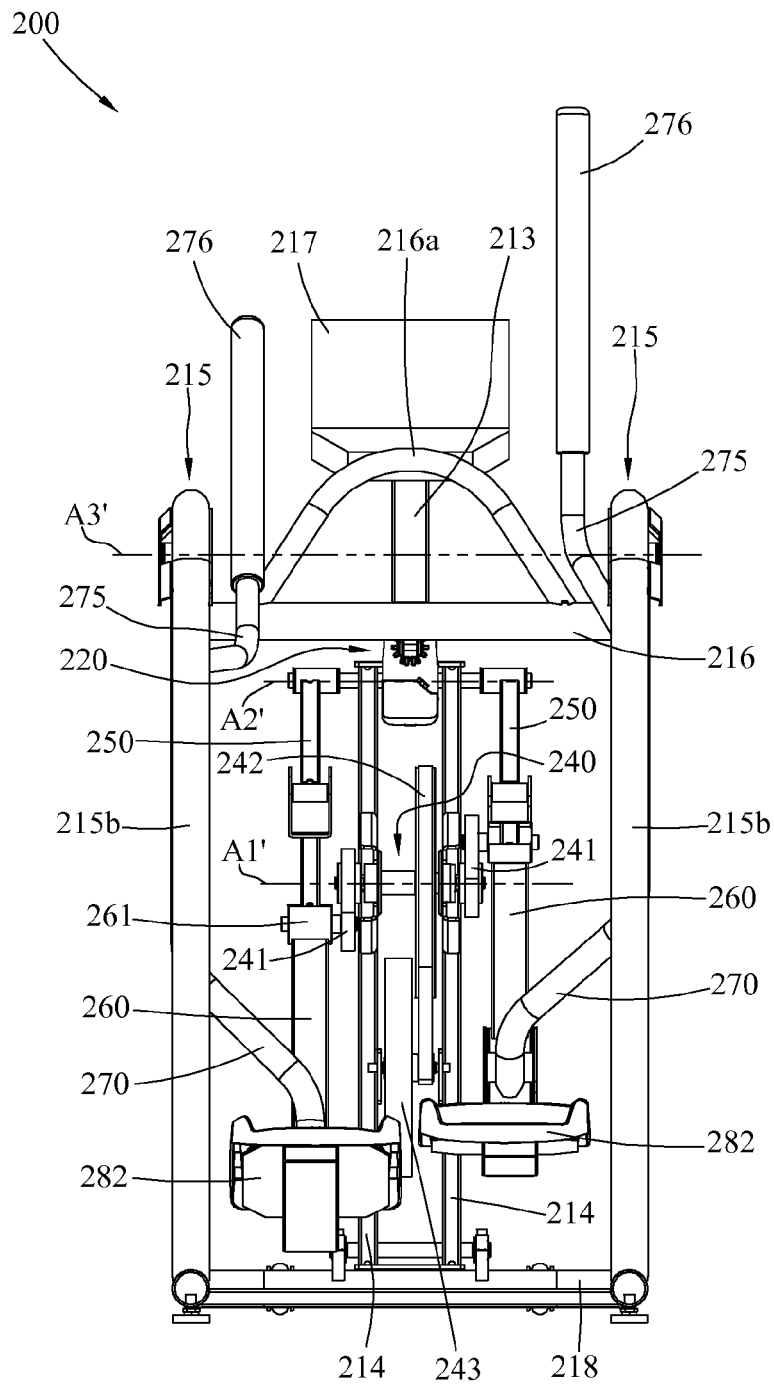


Fig. 13

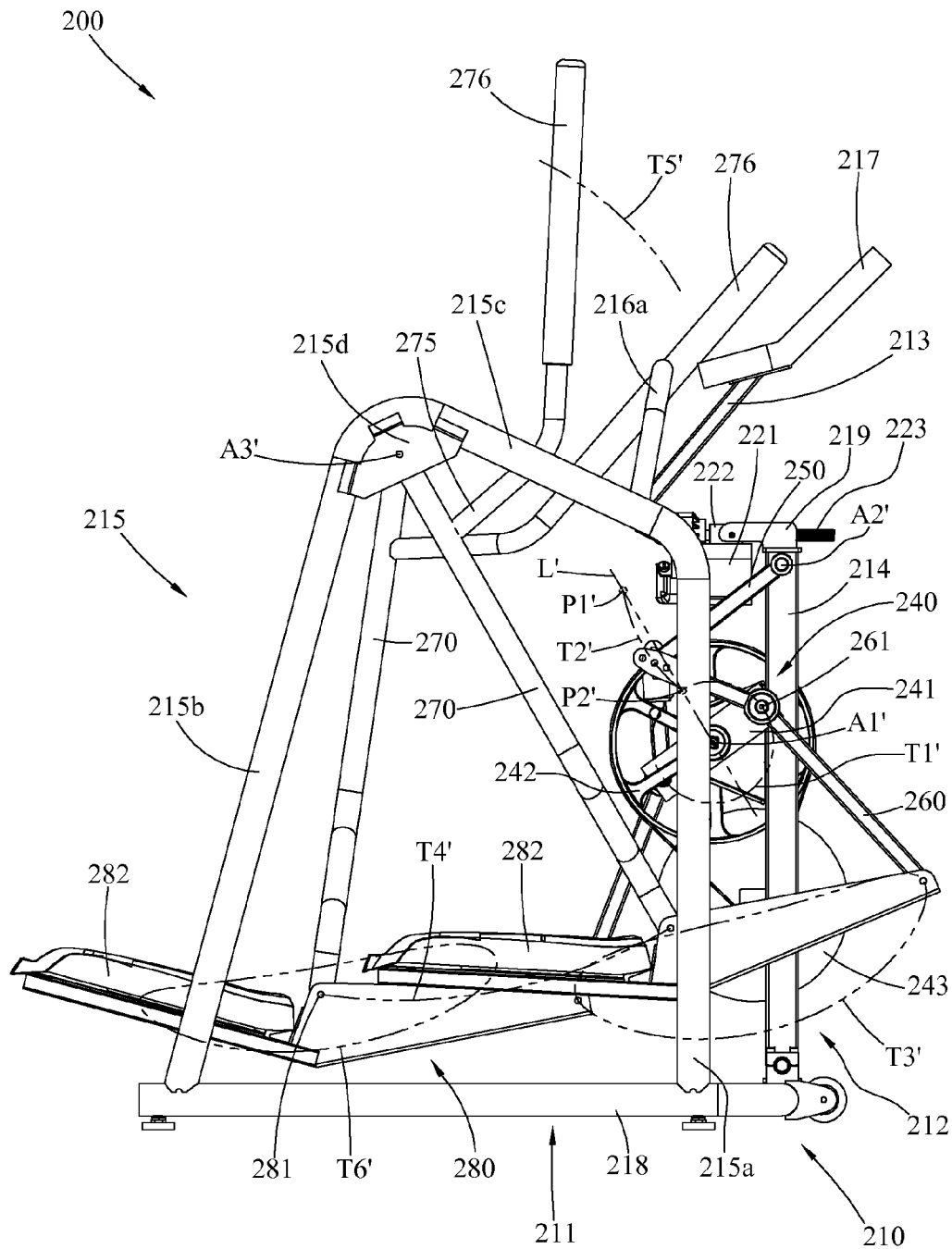


Fig. 14

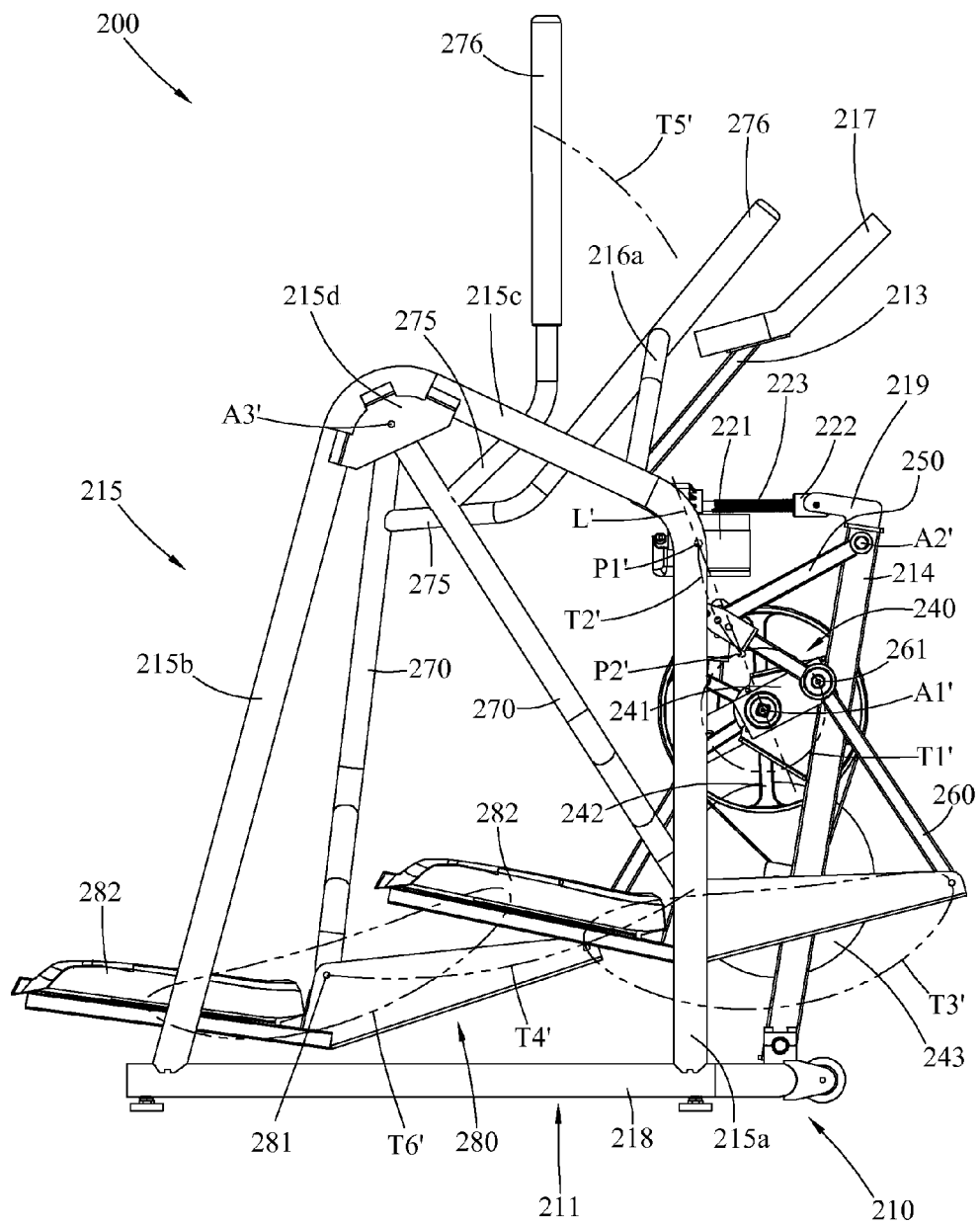


Fig. 15

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**EXERCISE APPARATUS****RELATED APPLICATIONS**

The application claims priority to China Application Serial  
Number 201210081616.7, filed May 26, 2012.

**BACKGROUND****1. Technical Field**

The present disclosure relates to an exercise apparatus.  
More particularly, the present disclosure relates to the exer-  
cise apparatus (or called "Elliptical") which can guide user's  
foot to move along an elliptic closed path.

**2. Description of Related Art**

The "Elliptical" or "Elliptical exercise apparatus" is an  
exercise apparatus which can guide a user's foot to move  
along an elliptic closed path, such as a stationary exercise  
apparatus disclosed in U.S. Pat. No. 5,540,637. This kind of  
exercise apparatus faces the dilemma of having a longer pedal  
stroke or occupying a smaller footprint. For example, the  
longer the crank units' length of the stationary exercise appa-  
ratus is, the longer the pedal stroke (a long axis length or a  
front-rear direction length) is. Although the longer pedal  
stroke provides an adequate leg exercise for the user, the  
length of the stationary exercise apparatus increases so that it  
occupies larger space and area. On the other hand, a shorter  
crank units' length help save the space, but it will restrict the  
leg exercise. Especially in models designed for home, how to  
design the structure of the exercise apparatus to be more  
streamline and smaller under the premise of providing suffi-  
cient exercise or to provide a longer stroke of movement  
under the stringent limitation of volume or length has become  
one of the efforts in the direction of the related designer.

In addition to design the pedal path having the sufficient  
length, the overall shape and the dynamic of the path should  
conform with ergonomics in order to have the natural and  
comfortable leg movement. For counterexample, improper  
length ratio of a major axis and a minor axis of the pedal path  
like a too flat or round ellipse, obvious asymmetry of the  
closed path like an oval, the top side of the closed path forms  
a concave arc like meniscus, or (compare with the crank units  
which rotate in a constant speed) the pedals move unsteadily  
along the path, all of these conditions can lead the user to feel  
unnatural or unsmooth during exercising.

Apart from having the sufficient total length, if the angle  
respect to the ground of the pedal path is designed adjustable,  
that is, the pedal path is "inclination adjustable" or "slope  
adjustable", and conforms with ergonomics within the adjust-  
ment range as well, then this kind of exercise apparatus can  
provide an even richer and more comprehensive training for  
the user.

When the exercise apparatus having a sufficient space,  
such as U.S. Pat. No. 5,540,637, the handles design is usually  
not a problem, and can be very easy on designing the ergo-  
nomic handles. However, when the space is narrowed, setting  
the handles properly within the limited space and looking  
after three sides of lower-cost, easy manufactured, as well as  
ergonomics conformed are difficult problems. For example,  
an arm 140 of U.S. Pat. No. 7,153,239 is extended upward to  
form a handle 144. The arm 140 and the handle 144 are jointly  
and pivotally coupled to the inner side of the U-shaped frame.  
Although the foregoing mechanism is simple and easy to  
manufacture, it has at least two disadvantages. First, the inner  
side of the U-shaped frame and the upper side of a pedal 133  
of an elliptical 100 are an exercising space supplied for the  
user obviously. If the handles are pivotally coupled to two

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ends of the inner side of the U-shaped frame respectively, it  
will directly reduce the exercising space and more likely  
cause inconvenient to use and non-ergonomic. On the other  
hand, if the width between two pivotal points of the two  
handles 144 meets the basic needs, it would increase the  
whole width of the frame. Second, the handles are unilateral  
pivotally coupled to the U-shaped frame. The handles are  
more prone to malfunction due to the unilateral force.

Moreover, the manufacturers want to reduce the storage  
and transportation costs of the exercise apparatus (as a variety  
of indoor exercise apparatuses), so that they usually disas-  
semble the exercise apparatus into several parts and congest it  
into a smaller carton when packaging. After purchasing the  
exercise apparatus, the user must be in accordance with the  
guidelines of the assembly manual to build the scattered parts  
up to a completed exercise apparatus. In this way, the opera-  
tion will be very tedious and laborious for the user.

**SUMMARY**

According to one embodiment of the present invention, an  
exercise apparatus includes a frame, an adjusting mechanism,  
a crank assembly, first and second reciprocating members,  
first and second linkages, first and second swing arms and first  
and second supporting arms. The frame has a fixed unit and a  
movable unit which is movable relative to the fixed unit. The  
adjusting mechanism is coupled to the frame for orienting the  
movable unit. The crank assembly has a pair of crank units  
which are respectively and pivotally coupled to the frame  
about a first axis. The two reciprocating members are respec-  
tively and pivotally coupled to the frame about a second axis.  
Each linkage has a first connecting portion, a second connect-  
ing portion and a third connecting portion. The first connect-  
ing portions are respectively and pivotally coupled to the  
crank units and move along a circular path about the first axis.  
The second connecting portions are respectively and pivot-  
ally coupled to the first and second reciprocating members  
and move reciprocally between a first and second retracing  
points of a curved path about the second axis. The second  
connecting portions are respectively higher than the first con-  
necting portions. The first retracing point is higher than the  
second retracing point of the curved path. The third connect-  
ing portions are respectively lower than the first connecting  
portions. Each swing arm has a top end and a bottom end. The  
top ends are respectively and pivotally coupled to the frame  
about a third axis. Each supporting arm has a first part, a  
second part and a third part. The first part are respectively  
and pivotally coupled to the bottom ends of the first and second  
swing arms. The second parts are respectively arranged in  
front of the first parts and are pivotally coupled to the third  
connecting portions of the first and second linkages for mov-  
ing along a first closed path. The third parts are respectively  
arranged behind the first parts for supporting a user's feet and  
are moved along a second closed path. At least one of the first  
axis, the second axis and the third axis is arranged on the  
movable unit of the frame. When the movable unit is moving,  
the relative position among the first axis, the second axis and  
the third axis and the shape or the inclination of the second  
closed path relative to the ground will be changed.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The present invention will be apparent to those skilled in  
the art by reading the following detailed description of a  
preferred embodiment thereof, with reference to the attached  
drawings, in which:



FIG. 1 is a perspective view of the right rear of an exercise apparatus according to one embodiment of the present invention;

FIG. 2 is a right front perspective view of FIG. 1;

FIG. 3 is a front view of FIG. 1;

FIG. 4 is a right view of FIG. 1;

FIG. 5 is a right rear perspective view of the packaged exercise apparatus;

FIG. 6 is a front view of FIG. 5;

FIG. 7 is a right view of FIG. 5;

FIG. 8-A and FIG. 8-B are enlarged fragmentary views of the vicinity of an instrument bar (without unrelated elements) and show a using state and a packaging state respectively;

FIG. 9 is an enlarged fragmentary view of the vicinity of a swing arm and a rocker (without unrelated elements) and shows the packaging state;

FIG. 10 is an enlarged fragmentary view of the vicinity of a carrying arm (without unrelated elements) and shows the packaging state;

FIG. 11-A and FIG. 11-B are enlarged fragmentary views of the vicinity of a bottom frame (without unrelated elements) and show the using state and the packaging state respectively;

FIG. 12 is a perspective view of an exercise apparatus according to another embodiment of the present invention;

FIG. 13 is a front view of FIG. 12;

FIG. 14 is a right view of FIG. 12; and

FIG. 15 is a right view of FIG. 12 when the movable unit is inclined.

#### DETAILED DESCRIPTION

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically depicted in order to simplify the drawings.

Referring to FIGS. 1-4, according to one embodiment of the present invention, an exercise apparatus has a frame 10 steadily setting on the ground. The frame 10 includes a bottom unit 11, a stand unit 12 coupled to the top of the bottom unit 11, and an instrument bar 13 coupled to the top of the stand unit 12. The stand unit 12 has two front pillar 14 which are relatively forward and parallel, two side pillar 15 which are relatively rearward and oriented at the left and right side respectively, and a U-shaped rod 16 connecting the top of the front pillar 14 and the top of the side pillar 15. An opening of the U-shaped rod 16 towards the rearward, which allows a user to intervene between the left and right side portions of the opening. The instrument rod 13 is the extension of the top of the front pillar 14 and the top end of the instrument rod 13 has a console 17.

There is a crank assembly 40 oriented at approximate middle height of the front pillar 14 of the stand unit 12. The crank assembly 40 has a crank shaft (not numbered) which is pivotally couple to the front pillar 14 about the left and right direction and a pair of crank units 41 which are symmetrically coupled to the two ends of the crank shaft respectively. A large pulley 42 is coaxially arranged between the two cranks 41 of the crank shaft. At the same time, the bottom of the crank assembly 40 additionally has a flywheel 43 and a small pulley 44. The flywheel 43 and the small pulley 44 are coaxially coupled to each other and pivotally connected to the front pillar 14. There is a pulley-belt 45 coupled to the large pulley 42 and the small pulley 44 so that the crank assembly 40 and

the flywheel 43 rotate with each other at a predetermined speed ratio. Although there is not shown in FIGS. 1-4, the present embodiment can be selectively set a resistance assembly which can provide a predetermined resistance to the flywheel 43. For example, an eddy-current brake controlled by the console 17 for providing the user to adjust the rotational resistance of the crank assembly 40 (corresponding to the degree of the user's exercising difficulty). The usage of the inertia flywheel and the resistance assembly are the generic learning prior art of this kind of exercise apparatus. Besides, the forgoing technique has no direct connection to the main feature of the present embodiment. For this reason, there is only a brief description herein.

An extending cantilever 18 is arranged near the top end of the front pillar 14 of the stand unit 12. There are two reciprocating members 50 oriented in the left and right side of the cantilever 18 respectively. The shapes of the two reciprocating member 50 are symmetrical. Each reciprocating member 50 has a first end which is relatively forward and a second end which is relatively rearward. Each first end is pivotally connected to the front end of the cantilever 18, and the pivots of the first ends of the two reciprocating members 50 are formed coaxially. The pivots form a pivot axis A2 (hereinafter referred as a second axis) parallel to a common pivot axis of the two crank units 41 (i.e., a crank axis of a crank shaft, hereinafter referred as a first axis A1). The two reciprocating members 50 can be moved relative to each other despite they have the same pivot axis.

Each left and right side of the stand unit 12 of the front pillar 14 has a longitudinally extended linkage 60. A predetermined portion (hereinafter referred as a first connecting portion 61) oriented between the top end and bottom end of each linkage 60 is pivotally connected to the outer end of the relative crank unit 41. As shown in FIG. 4, the linkage 60 is restricted moving along a predetermined circular path T1 which rotates about the crank axis of the crank shaft and takes the length of the crank unit as a radius (Note: "The length of the crank unit" is defined herein as a distance between the crank axis of the crank shaft and a axis of the first connecting portion 61 in a lateral view). Due to the symmetric crank units 41, the first connecting portions 61 of the linkages 60 are 180 degrees corresponding to each other on the circular path T1 in the lateral view. The top end of each linkage 60 (hereinafter referred as a second connecting portion) is pivotally coupled to the second end of the corresponding reciprocating member 50. Because of the preset member relations (including the relative position of the first axis A1 and the second axis A2, the length of the crank unit, the length and direction of the reciprocating member 50, etc.), the first connecting portion 61 of the linkage 60 is moved along the circular path T1, the second connecting portion of the linkage 60 is moved between two endpoints (hereinafter referred as a first retracing point P1 and a second retracing point P2) and is moved along a predetermined curved path T2 about the second axis A2. Moreover, the second connecting portions of the linkages 60 is substantially moved reversely along the curved path T2 in the lateral view.

The first connecting portion 61 of the linkages 60 is moved along the circular path T1, the second connection portion is moved reciprocally along the curved path T2 simultaneously, and the bottom of the linkage 60 (hereinafter referred as a third connecting portion) is moved along a first closed path T3 which is generally elliptical-like shaped. The third connecting portion of the linkage 60 will be oriented in a substantially opposite position on the first closed path T3 in the lateral view. For example, when one of the third connecting portions

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is oriented in the front region of the path, the other will be oriented in the opposite rear region.

There is a longitudinally extended swing arm **70** oriented behind the bottom end of each linkage **60**. The top ends of the two swing arms **70** are pivotally coupled to the both sides of the opening of the U-shaped rod **16** of the stand unit **12** respectively so that the bottom end of each swing arm **70** can be moved back and forth along a swing path **T4** about a third axis **A3**. In addition, the near top of each swing arm **70** is connected to an upward extended rocker **75**. The top of the rocker **75** is higher than the third axis **A3** and is formed as a handle **76** which can be gripped by the user. The handle **76** also can be moved back and forth along a swaying path **T5** about the third axis **A3**, and be moved opposite to the bottom end of the corresponding swing arm **70**.

The bottom of each swing arm **70** has a longitudinally extended carrying arm **80** which has a predetermined part (hereinafter referred as a first part **81**) oriented between a front end and a rear end of the carrying arm **80**. The first part **81** is pivotally connected to the bottom end of the corresponding swing arm **70** so that the first part **81** is restricted to move along the swing path **T4**. The front end of each carrying arm **80** (hereinafter referred as a second part) is pivotally connected to the bottom end (i.e., the third connecting portion) of the corresponding linkage **60** so that the second part is restricted to move along the first closed path **T3**. The second parts of the carrying arms **80** will remain in substantially opposite positions on the first closed path **T3** in the lateral view. Generally speaking, the first parts **81** of the carrying arms **80** are moved reversely along the swing path **T4** and the handles **76** are also moved reversely along the swaying path **T5**.

The inner surface of the rear region of each carrying arm **80** has a pedal **82** which is oriented at the rearward of the first part **81** to form a third part for carrying the user's foot. The front end of the carrying arms **80** (i.e., the second part) is moved along the first closed path **T3** and the first part **81** is moved along the swing path **T4**. Combining the movements of the second part and the first part **81**, the pedal **82** will be moved along a second closed path **T6** which is generally elliptical-like shaped (Note: The path **T6** shown in FIG. 4 is the path of the rearmost end of the pedal **82**.) The two pedals **82** will remain in substantially relative position on the second closed path **T6**. For example, one pedal is oriented at the front region of the path, and the other one will be oriented at the opposite rear region.

The user steps on the pedals **82** and grips the handles **76** when using the exercise apparatus. The user forces to move the pedals **82** and the handles **76** appropriately along each established path, that is the two pedals **82** are moved reversely along the second closed path **T6** and the two handles **76** are moved reversely along the swaying path **T5**. Moreover, the same side of the handle **76** and the pedal **82** are moved opposite to each other and thereby the user can have a full-body exercising. The user can obtain a smooth and stable predetermined inertia through the flywheel **43** and the resistance assembly. Besides, the user can adjust the degree of exercising difficulty according to his/her need.

Because of the structure and specific components relationship of the present embodiment, the exercise apparatus provides the sufficient pedal stroke under its smaller volume and shorter length to achieve the purpose of space saving. Meanwhile, the overall shape of the pedal path (like **T6** shown in FIG. 4) as well as the pedal dynamic motion are not only ergonomics conformed but also natural and comfortable for the user. The following are the further descriptions of the present embodiment:

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Referring to FIG. 4, the top end of the linkage **60** (i.e., the second connecting portion) corresponds to the curved path **T2** which is longitudinally extended and oriented above the circular path **T1**. The circular path **T1** is corresponding to the first connecting portion **61** which is oriented at the middle of the linkage **60**. The bottom end of the linkage **60** (i.e., the third connecting portion) corresponds to the first closed path **T3** which is oriented below the circular path **T1** and substantially rendered as an ellipse. The length of a minor axis of the first closed path **T3** is approximately equal to a diameter of the circular path **T1**. The length of a major axis of the first closed path **T3** is significantly greater than the diameter of the circular path **T1**. The length of the major axis of the first closed path **T3** is approximately three times greater than the diameter of the circular path **T1** in the present embodiment. The magnification mainly depends on a ratio of an lower length (a distance between the first connecting portion **61** and the third connecting portion) and an upper length (a distance between the first connecting portion **61** and the second connecting portion) of the linkage **60** in a lateral view. In other words, the longer the lower length of the linkage **60** is, the longer the major axis of the first closed path **T3** is. If the lower length is too long, the top side of the first closed path **T3** forms a concave arc, and it will not conform with ergonomics. Therefore, the ratio should be controlled within a proper range. For example, the lower length is greater than the upper length of the linkage **60**, and it is also greater than the diameter of the circular path **T1**. However, the lower length of the linkage **60** is not greater than three times of the diameter.

The first part **81** which is oriented at the middle of the carrying arm **80** corresponds to the swing path **T4**. The swing path **T4** is longitudinally extended and is oriented behind the first closed path **T1** which corresponds to the front end of the carrying arm **80** (i.e., the second part) so that the pedal **82** can be moved along the second closed path **T6** which is substantially rendered as an ellipse as well. The major axis of the second closed path **T6** is substantially equal to the major axis of the first closed path **T3**. In other words, the stroke of the pedal **82** is about three times the diameter of the circular path **T1** in the present embodiment. Comparing to heretofore known exercise apparatus (e.g., the structure of U.S. Pat. No. 5,540,637), the pedal stroke is usually equal to the diameter of the circular path. The present embodiment provides the same pedal stroke through the shorter crank unit. The length of the crank unit determines the total length of the exercise apparatus, so the present embodiment can provide a shorter length of the exercise apparatus and saving space.

Incidentally, if the position of the curved path **T2** and the circular path **T1** is reversed, that is if the top end of the linkage **60** is restrictedly moved along a circular path, a predetermined portion between the top end and the bottom end of the linkage **60** will be restrictedly moved along a longitudinal path at the same time. Although the bottom end of the linkage **60** is corresponding moved along a closed path, the amplification effect of the length of the major axis of the closed path is worse than the amplification effect of the length of the crank unit, and the shape of the path is similar to a semicircle rather than an ellipse so that this kind of arrangement is not practical.

The curved path **T2** is close to the top rear of the circular path **T1** in the present embodiment and the first retracing point **P1** of the curved path **T2** is oriented at the top rear of the second retracing point **P2**. The first retracing point **P1** is higher than the second retracing point **P2**. The first retracing point **P1** and the second retracing point **P2** define a straight line **L** which is down through the circular path **T1**. The better condition is that the straight line **L** passes through the center of the circular path **T1** as shown in FIG. 4. The straight line **L**

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(representing the direction of the reciprocated movement of the linkage 60) of the present embodiment passes through the circular path T1, or even passes through its center so that the shape of the two halves of the first closed path T3 are more symmetrical and the shape of the second closed path T6 is corresponding more symmetrical, too. For example, there is less likely to have an oval path which has one rounded end and the other pointed end.

The straight line L is preset tilt rather than perpendicular to the ground in order that the major axis of the first closed path T3 has a predetermined elevation angle (which means the front end is appropriately higher than the rear end) respect to the ground. As a result, the second closed path T6 has a corresponding shape to adapt to user's leg movement. Furthermore, as shown in FIG. 4, in order to tilt the first closed path T3 and not to increase the total length of the exercise apparatus due to the position shaft of the first closed path T3, the bottom end of the linkage 60 (i.e., the third connecting portion) is oriented at the rearward of an extension line (not shown) which is passing from the top end (i.e., the second connecting portion) to the first connecting portion 61 in the present embodiment.

The exercise apparatus of the present embodiment has a space-saving feature in a using state as described. The following will describe a packaging state of the exercise apparatus when it is leaving the factory, and the user's assembling work after purchasing the exercise apparatus.

Referring to FIGS. 5-7 which are shown a constriction structure of the packaged exercise apparatus. Comparing FIGS. 6-7 (Note: The rectangular border shows the carton size) with FIGS. 3-4 respectively, the height and the length of the packaged exercise apparatus are significantly less than the height and the length of the exercise apparatus in the using state. The packaged exercise apparatus not only renders as a high density structure but also effectively saves packaging materials, storing fees, and shipping costs. In order to facilitate the assembly operations for the user after purchasing the exercise apparatus. The exercise apparatus is not using the conventional packaging skills which is disassembling the exercise apparatus into several components, but uses some proper folded structures for temporarily folding the exercise apparatus into the packaging state (or not assembling into the using state) before the exercise apparatus leaves the factory. Before using the exercise apparatus for the first time, the user then unfolding and locking it into the using state. The following four parts of the folded structures include the instrument bar 13, the rocker 75, the carrying arm 80, and the bottom unit 11 of the frame 10 will be described sequentially.

Referring to FIG. 8-A and FIG. 8-B, the instrument bar 13 is pivotally coupled to the stand unit 12 by a releasable or a lockable manner. In more details, a carrying seat 19 is arranged on an intersection of the front pillar 14 of the stand unit 12 and the U-shaped rod 16. A joint seat is arranged on one end of the instrument bar 13 (i.e. the bottom end when using) which is away from the console. The front edge of the joint seat is pivotally coupled to the front edge of the carrying seat 19 of the stand unit 12 via a lateral pivot shaft 22 so that the instrument bar 13 can be folded downward from FIG. 8-A to FIG. 8-B. The folded instrument bar 13 is positioned between the two side pillars 15 as shown in FIGS. 5-7. The carrying seat 19 of the stand unit 12 has a wiring hole 23 and a screw hole 24, and the joint seat 21 of the instrument bar 13 has a wiring hole 25 and a perforation 26. The wiring hole 23 and the screw hole 24 are corresponding to the wiring hole 25 and the perforation 26 respectively. When doing the assembly operations, the user unfolds the instrument bar 13 to connect the joint seat 21, and then a bolt (not shown) locks through the

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perforation 26 to the screw hole 24. As a result, the instrument bar 13 will be locked in a predetermined position which is free to use. The wiring holes 23, 25 have wires (not shown) which are electrically connected to the console 17 and the resistance assembly. According to the different designs, the user may or may not be required to set the wires before assembling the instrument bar 13.

Referring to FIG. 9 (Note: It shows a fragmentary structure of the lift side of the exercise apparatus), each rocker 75 is pivotally coupled to the corresponding swing arm 70 by a releasable or a lockable manner. In more details, a carrying seat 71 is coupled to close to the top end of each swing arm 70. A joint seat 77 is relatively coupled to one end of each rocker 75 (i.e. the bottom end of the rocker 75 when using) which is away from the handle 76. The carrying seat 71 is pivotally and parallelly connected to the joint seat 77 via a diagonal pivot shaft 72 which is extended from the rear top to the front bottom, so that each rocker 75 is extended from the upward to the other side (e.g., the left rocker is extended to the right side as shown in FIG. 9) and is substantially positioned in an area enclosed by the U-shaped rod 16 as shown in FIGS. 5-7. The carrying seat 71 of each swing arm 70 has a perforation 73, and the joint seat 77 of each rocker 75 has a screw holes 78 which is corresponding to the perforation 73. When doing the assembly operations, the user unfolds the rocker 75 to connect the swing arm 70, which means the screw holes 78 will correspond to the perforation 73, and then a bolt (not shown) locks through the perforation 73 to the screw hole 78. As a result, the rocker 75 will be relatively locked to the swing arm 70 in a predetermined position which is free to use.

Referring to FIG. 10 (Note: It shows a fragmentary structure of the right side of the exercise apparatus), each carrying arm 80 comprises a front bar 83 and a rear bar 84. Each front bar 83 is pivotally connected to the corresponding rear bar 84 by a releasable or a lockable manner. In more details, the front end of the front bar 83 is pivotally coupled to the bottom end of the swing arm 70 to form a first part 81, and the rear end of the front bar 83 is pivotally coupled to the bottom end of the linkage 60 to form a second part. The rear half of the rear bar 84 is formed a third part which is carrying the user's foot, and the front end of the rear bar 84 is pivotally coupled to a bracket 86 which is oriented close to the rear end of the front bar 83 via a lateral pivot shaft 85. Therefore, the rear bar 84 of the carrying arm 80 can be extended from the backward to the upward, as shown in FIGS. 5-7 and FIG. 10. The rear top of each front bar 83 has a carrying seat 87, and the front bottom of each rear bar 84 has a joint seat 88 which is corresponding to the carrying seat 87. When doing the assembly operations, the user unfolds the rear bar 84 to connect the front bar 83, which means the joint seat 88 will correspond to the carrying seat 87, and then a bolt 89 locks through the joint seat 88 to the screw hole 91 of the carrying seat 87. As a result, the carrying arm 80 will be locked as the using state.

Referring to FIG. 11-A and FIG. 11-B, the bottom unit 11 comprises a fixed frame 27 and two folded rods 28 which are pivotally coupled to the rear end of the fixed frame 27 by a releasable or a lockable manner. In more details, the fixed frame 27 is the connective base of the stand unit 12 and has two parallel side rods 29. The rear half of the two side rods 29 form a storage space and an opening of the two side rods 29 toward the rearward. One end of each folded bar 28 (i.e. the front end of the folded bar when using) is pivotally connected to a bracket 33 which is oriented close to the rear end of the corresponding side rod 29 via a vertical pivot shaft 32. In this way, each folded bar 28 is extended from the backward as shown in FIG. 11-A to the other side as shown in FIG. 11-B and it is positioned in the storage space 31 of the fixed frame

27. The rear end of each side rod **29** has a downward embedded seat **34** and each folded bar **28** has a corresponding upward embedded seat **35**. When doing the assembly operations, the user unfolds the side rod **29** to connect the fixed frame **27**, which means the upward embedded seat **35** will correspond to the downward embedded seat **34** and a post (not shown) which is oriented at the bottom of the downward embedded seat **34** engages with a recess **36** which is oriented at the upward embedded seat **35**. Therefore, the folded bar **28** will be located at a predetermined position for expanding the supporting area of the bottom of the frame **10**. A circular pivot hole is arranged on the bottom end of the bracket **33** and an elliptical pivot hole is arranged on the top end of the bracket **33**. The vertical pivot shaft **32** passes through the circular pivot hole and the elliptical pivot hole. The folded bar **28** is pivotally coupled to the bracket **33** via the vertical pivot shaft **32**. When the user unfolds the folded bar **28** close to the using state, the user can force the upward embedded seat **35** to skip the post of the downward embedded seat **34** (or slightly elevate the fixed frame **27** if necessary), then the recess **36** can engage with the post.

To sum up, after unpacking the packaging carton (and possibly some positioning materials) of the exercise apparatus, the user can sequentially unfold the two folded rods **28** of the bottom unit **11**, the rear bars **84** of the two carrying arms **80**, the two rockers **75**, and the instrument bar **13** back to their foregoing predetermined positions, and assembles the exercise apparatus rapidly and simply from the packaging state to the using state. If necessary, for example, when the exercise apparatus is not using, storing or transferring, the user may also fold it into the packaging state.

The following descriptions are the exercise apparatus according to another embodiment of the present invention. The general structure of this embodiment is the same as the foregoing described embodiment, in order to avoid being lengthy, there are solely detailing the differences.

Referring to FIGS. **12-14**, according to another embodiment of the present invention, an exercise apparatus **200** has a frame **210** which comprises a fixed unit **211** and a movable unit **212**. The fixed unit **211** includes a bottom unit **218** setting on the ground, two stand units **215** coupled to the top end of the bottom unit **218**, a cross bar **216** coupled between the two stand units **215** and an instrument bar **213** coupled to the cross bar **216**. The two stand units **215** are symmetrically and respectively formed in invert U-shape. Each stand unit **215** has a front bar **215a**, a rear bar **215b** and a cross bar **215c** which is connected between the front bar **215a** and the rear bar **215b**. Besides, two fixed plates **215d** are arranged below the junction of the rear bar **215b** and the cross bar **215c** of the stand unit **215**. The two stand units **215** and the cross bar **216** define an exercising space which allows the user to enter from the rear. On the other hand, a fixed armrest **216a** is arranged on the cross bar **216** and a console **217** is arranged on the top end of the instrument rod **213** which is in front of the fixed armrest **216a**. The movable unit **212** includes two parallel front pillars **214** oriented between the two front bars **215a**. The top ends of the two front pillars **214** are connected to a connector **219**, and the bottom ends of the two front pillars **214** are pivotally connected to the bottom unit **218** of the fixed unit **211** via a lateral pivot shaft, so that the front pillars **214** can be rotated forward or backward relative to the fixed unit **211**.

There is an adjusting mechanism **220** arranged between the connector **219** of the front pillar **214** and the cross bar **213** of the fixed unit **211**. The adjusting mechanism **220** includes a motor assembly **221**, a screw **223** and a nut **222**. The rear end of the motor assembly **221** is coupled to the cross bar **216** of

the fixed unit **211**. One end of the screw **223** is extended longitudinally and pivotally coupled to the motor assembly **221**. The nut **222** is pivotally connected to the connector **219** of the top end of the front pillar **214** and is passed through by the screw **223**. The screw **223** can be rotated forward or reversely about its axis by the motor assembly **221**, so that the nut **222** can be moved along the screw relative to the ground. As a result, the two front pillars **214** can be moved forward or backward about its bottom pivot shaft and can be located at a predetermined position within a scope. The scope is defined between a position of the front pillar **214** (hereinafter referred as a first position) as shown in FIG. **14** and a position of the front pillar **214** (hereinafter referred as a second position) as shown in FIG. **15** in the present embodiment. In more details, the adjusting mechanism **220** can be located at the first position, the second position or between two of them.

The crank assembly **240** is arranged on an approximate middle position of the front pillar **214** of the movable unit **212**. The crank assembly **240** has two crank units **241** and a crank shaft (not numbered). The crank shaft is pivotally coupled to the front pillar **214** about a first axis **A1'** and the two crank units **241** are coupled to the two end of the crank shaft respectively. When the front pillar **214** is rotated by the adjusting mechanism **220**, the crank assembly **220** is moved relative to the fixed unit **211** simultaneously. In addition, the bottom of the crank assembly **240** has a flywheel **243** which can provide inertial and resistance coordinating with the resistance assembly (not shown).

The top ends of the two front pillars **214** have two rod-like reciprocating members **250** respectively. The difference between the present embodiment and the foregoing embodiment is that the two reciprocating members **250** are pivotally coupled to the two sides of the movable unit **212** about a second axis **A2'** which is moved with the movable unit **212** of the frame **210**. Please referring to the described embodiment for other details about the reciprocating members **250**.

Two longitudinally extended linkages **260** are oriented at the outer sides of the two front pillars **214** respectively. The connection between each linkages **260** and the peripheral structure is the same with the foregoing embodiment. A first connecting portion **261** of the linkage **260** is moved along a circular path **T1'** and the top end of the linkage **260**, a second connecting portion, is moved along a predetermined curved path **T2'** about the second axis **A2'**. The curved path **T2'** has two retracing points (hereinafter referred as a first retracing point **P1'** and a second retracing point **P2'**) and the second connecting portion is moved between the two retracing points. The two second connecting portions of the two linkages **260** are moved reversely along the curved path **T2'** in the lateral view.

Combining the movements of the first connecting portion **261** which is moved along the circular path **T1'** and the second connecting portion which is moved along the curved path **T2'**, the bottom end of the linkage **260** (hereinafter referred as a third connecting portion) will be moved along a first closed path **T3'** which is generally elliptical-like shaped. Besides, the two third connecting portions will be located at the corresponding positions on the first closed path **T3'**.

A longitudinally extended swing arm **270** is oriented behind the rear end of each linkage **260**. The top ends of the two swing arms **270** are pivotally coupled to the two stand units **215** of the fixed unit **211** respectively. In details, the top end of each swing arm **270** is oriented between two fixed plates **215d** and is pivotally coupled to the fixed plates **215d**. Therefore, the top end of the swing arm **270** and even below the approximate two-thirds of the length of the swing arm **270** are oriented at the same vertical plane with the corresponding

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stand unit **215**. No matter from the back side, the front side or the top side of the exercise apparatus **200**, the top ends of two swing arms **270** can't be seen due to a part length of the swing arm **270** is surrounded by the corresponding stand unit **215**. That is the top ends of two swing arms **270** are obscured by the rear bars **215b** of the stand units **215**, two front bars **215a**, and two cross bars **215c** respectively. The bottom of each swing arm **270** can be moved back and forth along a swing path **T4'** about a third axis **A3'**.

Additionally, the near top of each swing arm **270** is connected to an upward extended rocker **275**. In details, the two rockers **275** extend toward an exercise space which is defined by the two stand units **215** and extend upward to the inner side of the two stand units **215**, so that the top of each rocker **275** is higher than the third axis **A3** and is formed as a handle **276** which can be gripped by the user. The handles **276** also can be moved back and forth along a swaying path **T5'** about the third axis **A3'**, and be moved opposite to the bottom end of the corresponding swing arm **270**. As shown in FIGS. **14-15**, the handles **276** are oriented at the front top of the third axis **A3'**, so the front end of the swaying path **T5'** is lower than its rear end. When the user pushes the handle **276** toward, the force direction and the movement are toward and downward. On the contrary, when the user pulls the handle **276** back, the force direction and the movement are backward and upward.

The structures of two carrying arms **280**, two pedals **282** and their connections with other elements are the same as the foregoing embodiment, so please referring to the described embodiment for details. Combining the movements of the second part of the carrying arm **280** which is moved along the first closed path **T3'** and the first part **281** which is moved along the swing path **T4'**, the pedal **282** will be moved along a second closed path **T6'** which is generally elliptical-like shaped. The second closed path **T6'** shown in FIGS. **14-15** is the moving path of the middle part of the pedal **282**.

The same with the described embodiment, the present embodiment can provide the sufficient pedal stroke under its smaller volume and shorter length to achieve the purpose of space saving. Meanwhile, the overall shape of the pedal path as well as the pedal dynamic motion are not only ergonomics conformed but also natural and comfortable for the user. Moreover, the user can control the position of the movable unit **212** of the frame **210** via the adjusting mechanism **220**, so that he/she may have a different pedal movement path relative to the ground. Referring to FIGS. **14-15**, the following are the further descriptions of the present embodiment:

The exercise apparatus **200** has the adjusting mechanism **220** which can locate the movable unit **212** of the frame between a first position (i.e. as shown in FIG. **14**, two front pillars **214** are substantially perpendicular to the ground) and a second position (i.e. as shown in FIG. **15**, a nut **222** is moved to the front end of a screw **223** and the two front pillars **214** are rotated along with the nut **222** to be located at about 81 degrees to the ground.) When the position of the movable unit **212** is changed, the track of the second closed path **T6'** is also changed with respect to the ground. In the user's point of view, the track changing of the second closed path **T6'** means the inclination changing and even its shape changing. In other words, when the user wants to change the exercising difficulty, he/she can achieve that goal not only by the resistance assembly (not shown) forcing the resistance to the flywheel **260**, but by manipulating a console **217** to control the adjusting mechanism **220** to adjust the inclination of the second closed path **T6'**. That is, the movable unit **212** of the frame **210** can be located at a position which is within the range defined by the first position and the second position, thereby changing

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the second closed path **T6'** with respect to the ground to achieve the purpose of adjusting the exercising difficulty.

When the adjusting mechanism **220** starts operating, the movable unit **212** of the frame **210** starts rotated, the first axis **A1'** and the second axis **A2'** will be moved along with the fixed unit **211** until the movable unit **212** is located at a predetermined position which is set by the user. Regardless of the movable unit **212** is located at any position, the exercise apparatus **200** can still have the ergonomic features. The reason is that the displacement of the movable unit **212** will not change the relative positions of the first axis **A1'** and the second axis **A2'**, the length of the crank unit **241**, the length of the reciprocating member **250**, the length between the first connecting portion **261** and the second connecting portion of the linkage **260**. For instance, as shown in FIG. **15**, during the movable unit **212** is moved from the first position to the second position, the first axis **A1'** and the second axis **A2'** will be rotated along with the front pillar **214**. At the same time, the front pillar **214** is rotated about its bottom end so that the distance between the first axis **A1'** and the second axis **A2'** remains unchanged. As shown in FIG. **14**, the first retracing point **P1'** and the second retracing point **P2'** define a straight line **L'** which is down through the circular path **T1'**. The better condition is that the straight line **L'** passes through the center of the circular path **T1'** so that the shape of the two halves of the first closed path **T3'** are more symmetrical and the shape of the second closed path **T6'** is still corresponding more symmetrical, too.

Comparing FIG. **14** and FIG. **15**, when the movable unit **212** is oriented at the second position, the front end of the first closed path **T3'** is closer to the ground than it is in FIG. **14**. In other words, the reason of the front end of the first closed path **T3'** is slightly lowered is that the first closed path **T3'** is formed by the relationship among the reciprocating members **250**, the crank assembly **240** and the linkage **260**, and those three elements are arranged on the movable unit **212** of the frame **210**. When the movable unit **212** is rotated forward, the first closed path **T3'** will be rotated forward along with the bottom end of the front pillar **214**. When the movable unit **212** is rotated from the vertical state to the tilting state, the front end of the first closed path **T3'** will go down and the rear end will go up surely. When the first closed path **T3'** is turned from FIG. **14** to FIG. **15**, its specific effect can then see the front end of the right supporting arm **280** (which is pivotally connected to the right linkage **260**), the first part **281** (which is pivotally connected to the right swing arm **270**), and the relative relationship of the rear end (of the pedal **282**) when the movable unit **212** is rotated. The right supporting arm **280** is a rigid body. When the front end of the right supporting arm **280** is close to the ground (i.e., the first closed path **T3'** shown in FIG. **15**), like a seesaw, any part which is oriented behind the first part **281** of the right supporting arm **280** will be rotated as FIG. **15**, and the middle part of the pedal **282** is no exception. As a result, the front end of the second closed path **T6'** in FIG. **15** is higher than in FIG. **14** and the slope of the second closed path **T6'** in FIG. **15** is also greater than in FIG. **14**.

More particularly, in order to change the inclination of the second closed path **T6'**, altering the positions of the first axis **A1'** and the second axis **A2'** is not the only way. In other possible embodiments, the crank shaft of the crank assembly (viewed as the first axis) can be arranged on the fixed unit of the frame and the shaft of the reciprocating member (viewed as the second axis) can be arranged on the movable unit. In the present embodiment, for example, the skilled person can easily arrange a cross bar (not shown) on the left and right stand units **215** corresponding to the first axis **A1'**, and alter the first axis **A1'** from the movable unit **212** to the cross bar.

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That is, the crank assembly **240** is arranged on the cross bar and the positions of the two reciprocating members **250** remain unchanged. Therefore, the inclination of the second closed path **T6'** can still be adjusted by changing the position of the reciprocating member **250**. With different inclinations, the shape of the second closed path **T6'** will be changed slightly. As long as the adjustment is within a reasonable range, the foregoing amendments not depart from one of the spirit of the present invention: "When the adjusting mechanism **220** moves the movable unit **212** of the frame **210**, the straight line **L'** defined by the two retracing points **P1'**, **P2'** of the curved path **T2'** is down through the circular path **T1'** in the lateral view," and still able to maintain a certain degree of ergonomic advantages.

If only by changing the position of the second axis **A2'** to achieve the purpose of adjusting the exercise intensity, respect to the second embodiment of the present invention may not require such a relatively high bearing capacity of the structure like the front pillar **214**. In order to save manufacturing costs, the designer may use a shorter rotating bar (not shown) to replace the front pillar **214** in other possible changes. For example, the length of the shorter rotating bar is only half of the front pillar, or even less. The bottom end of the rotating bar is pivotally connected to the fixing unit **211** of the frame **210** and its top end is similarly connected to the adjusting mechanism **220** for achieving the purpose of adjusting the position of the second axis.

Furthermore, in order to adjust the inclination of the second closed path **T6'**, altering the positions of the first axis **A1'** and the second axis **A2'** is not the only way, there is a way by changing the position of the third axis **A3'**. About the adjustment of the third axis **A3'**, please refer to U.S. Pat. No. 7,682,290, U.S. Pat. No. 7,744,508 or U.S. Pat. No. 7,976,435 which are applied by the applicant. As to how to apply those technologies to the present invention, a person has ordinary skill in the art to the field of exercising apparatuses should complete it without undue experimentations, so that the details are not narrated herein.

In the present embodiment, the adjusting mechanism **220** is electrical controlled, but the position of the movable unit **212** can be changed manually in other embodiments such as using a pin and a positioning hole. With some modifications of the related technologies of U.S. Pat. No. 7,654,936 or U.S. Pat. No. 7,846,071, then it can be applied in the present invention.

It should be added that the main advantages of the configuration of the handle **276** of the present embodiment are durable, remaining the current exercising space between two stand units **215**, remaining the current occupied space of the exercise apparatus and achieving better ergonomics. In details, the handle **276** is moved along the swaying path **T5'** about a bearing which is the pivotal junction of the top end of the swing arm **270** and its corresponding stand unit **215**. The two fixed plates **215d** which are fixed at the stand unit **215** are pivotally coupled to the top end of the two swing arms **270** respectively. Under the situation of sharing the stress equally and symmetrically to the two fixed plates **215d**, the structure of the present embodiment is stronger and more durable than the structure of U.S. Pat. No. 7,153,239. The bearing of the handle **276** is in the same vertical plane with the stand unit **215** but not at the inner side or the outer side of the stand unit **215** so that it will not affect the inner exercising space of the stand unit **215** or increase the outer occupied space. Additionally, referring to FIGS. 14-15, the front end of the second closed path **T6'** is in front of the third axis **A3'** in the lateral view. If the handles are directly arranged on the top ends of the corresponding swing arms (refer to U.S. Pat. No. 7,153,239) respectively, it will be surely just oriented on the both sides of

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the user's body respectively once the user step in the exercise apparatus and the situation like that is not conducive to the user's hands exercise. In this way, the handles of the present embodiment are arranged on the front top of the third axis **A3'**. Therefore, the user can grip the corresponding handle **276** to exercising smoothly and comfortably.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

What is claimed is:

1. An exercise apparatus comprising:

a frame having a fixed unit and a movable unit being movable relative to the fixed unit;

an adjusting mechanism coupled to the frame for orienting the movable unit;

a crank assembly having a pair of crank units which are respectively and pivotally coupled to the frame about a first axis;

first and second reciprocating members respectively and pivotally coupled to the frame about a second axis;

first and second linkages, each linkage having a first, second and third connecting portions, the first connecting portions respectively and pivotally coupled to the crank units and moving along a circular path about the first axis, the second connecting portions respectively and pivotally coupled to the first and second reciprocating members and moving reciprocally between a first and second retracing points of a curved path about the second axis, the first retracing and the second retracing points defining a straight line passing through the circular path, the second connecting portions respectively being higher than the first connecting portions and the first retracing point being higher than the second retracing point of the curved path, the third connecting portions respectively being lower than the first connecting portions;

first and second swing arms, each swing arm having a top end and a bottom end, the top ends respectively and pivotally coupled to the frame about a third axis; and

first and second supporting arms, each supporting arm having a first part, a second part and a third part, the first parts respectively and pivotally coupled to the bottom ends of the first and second swing arms, the second parts respectively arranged in front of the first parts and pivotally coupled to the third connecting portions of the first and second linkages for moving along a first closed path, the third parts respectively arranged behind the first parts for supporting a user's feet and moved along a second closed path;

wherein at least one of the first axis, the second axis and the third axis is mounted on the movable unit of the frame and at least one of distances among the first axis, the second axis and the third axis will be changed while the movable unit is moved by the adjusting mechanism whereby inclination of the second closed path relative to the ground will be changed when the movable unit is moving.

2. The exercise apparatus of claim 1, wherein the first and second reciprocating members are pivotally coupled to the movable unit of the frame.

3. The exercise apparatus of claim 2, wherein the two crank units of the crank assembly are pivotally coupled to the mov-

able unit of the frame, and the distance between the first axis and the second axis is the same when the movable unit is moving.

4. The exercise apparatus of claim 1, wherein the straight line substantially passes through the center of the circular path. 5

5. The exercise apparatus of claim 1, wherein a distance between the first connecting portion and the second connecting portion of the first or second linkage is defined as an upper length, a distance between the first connecting portion and the third connecting portion of the first or second linkage is defined as an lower length in the lateral view, and the lower length is greater than the upper length and the length of the diameter of the circular path. 10

6. The exercise apparatus of claim 5, wherein the lower length is less than three times the length of the diameter of the circular path. 15

7. The exercise apparatus of claim 1, wherein the first retracting point of the curved path is oriented in an upper back of the second retracting point in the lateral view. 20

8. The exercise apparatus of claim 1, further comprising first and second rocking rods, one end of each rocking rod respectively coupled to predetermined positions of the first and second swing arms, the predetermined positions respectively oriented below the top ends of the first and second swing arm. 25

9. The exercise apparatus of claim 1, the adjusting mechanism further comprising a motor assembly, a screw and a nut, the motor assembly coupled to the fixed unit, one end of the screw pivotally coupled to the motor assembly, and the nut passed through by the screw and pivotally coupled to the movable unit. 30

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